

Appendix C

ENGINEERING AND SYSTEMS ENGINEERING SOFTWARE

SUMMARY

This Appendix provides a brief description of typical commercial software commonly used in various engineering and systems engineering disciplines.

The sole intention of this Summary is to introduce to prospective users a few features of some of the available off-the-shelf computer software packages. It is not intended to introduce this list as inclusive nor up to date and users are encouraged to search the market for other packages that will best suit their particular needs. A description of a limited number of commercial packages is provided in alphabetical order for the following categories:

- * Data Base
- * Dynamic Analysis and Design tools
- * Matrix Computation with graphics capability tools
- * Symbolic Manipulation systems
- * Systems Engineering support tools

ORACLE

Data Base

APPLICATION

ORACLE is a fully relational data base management system. The system is based on the Structured Query Language (SQL) environment that provides an extremely powerful capability for searching the data base. ORACLE allows the user to develop custom applications and can store a very large amount of information when compared to others. It can be used to develop applications to provide information to project management and manage configuration management.

SYSTEM AVAILABILITY

386 and 486 based MS-DOS personal computers (PC's),
Sun 4/SPARC, variety of IBM and VAX platforms

ATTRIBUTES

ORACLE is menu driven and is constructed with application modules around the system kernel. These modules provide search and query capabilities, report generation tools, and graphic devices. ORACLE also has a "C" language interface that allows the user to connect the data base to programs developed off line. The system is highly portable allowing an application developed on one platform to be transported to another.

ADDITIONAL REQUIREMENTS

SOURCE

ORACLE Corporation
500 Oracle Parkway
Redwood Shores, CA 94065
(415)506-7000

TRACER

Data Base

APPLICATION

TRACER is a relational data base oriented tool supporting capture of requirements in a central data base, tracing of relationships among requirements and documents, tracing of change impact and approval status, production of status reports for managers and custodians, production of hard copy and electronic documents, and delivery of documents to electronic access via LAN. TRACER supports projects involving more than 25,000 requirements organized as a hierarchical set of documents, and is particularly useful in large projects.

SYSTEM AVAILABILITY

IBM AT or equivalents

ATTRIBUTES

TRACER is a database for requirements which provides instant electronic

access. The tool provides a mechanism for change management, and is amenable to networking with a shared database. TRACER's printout identifies unsubstantiated requirements so they can be eliminated.

ADDITIONAL REQUIREMENTS

SOURCE

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, CA 91109

Also:

COSMIC
The University of Georgia
382 East Broad Street
Athens, GA 30602-4272
(706)542-3265

DADS

Dynamic Analysis and Design

APPLICATION

DADS (Dynamic Analysis and Design System) is a mechanical Computer-Aided Engineering (CAE) software package that enables the simulation and analysis of complex mechanisms and mechanical systems. Multidisciplinary applications such as controls, hydraulics, and mechanical systems are incorporated in DADS, which includes flexible and rigid body elements.

SYSTEM AVAILABILITY

PC's: 486 based MS-DOS personal computers. Workstations: SGI, DEC, SUN, HP, IBM. Mainframes: IBM, DEC. Supercomputers: CRAY, Convex

ATTRIBUTES

DADS solves for displacement, velocity, acceleration and reaction forces of models. It performs static, kinematic, dynamic, and inverse dynamic analysis. It allows users to model real world behavior and interprets performance through plots, graphs, tables, and animation. DADS animation is especially suited for demonstration and simulation of designs to verify concepts and performance. Other features of DADS include: feedback, controls, hydraulics, and flexible bodies animation.

ADDITIONAL REQUIREMENTS

SOURCE

CADSI
2651 Crosspark Road
Coralville, IA 52241
(319)626-6700

NASTRAN

Dynamic Analysis and Design

APPLICATION

NASTRAN (NASA Structural Analysis) is a general purpose program that analyzes most kinds of structures and constructions by using the displacement method of the finite element approach. It provides engineers with a range of modeling and analysis capabilities. NASTRAN offers structural and modeling elements that represent common types of structural building blocks such as rods, beams, shear panels, plates, and shells of revolution. More general types of building blocks can be represented by combining these simple elements or by using a general element capability. NASTRAN allows users to incorporate the effects of control systems, aerodynamic transfer functions, and other nonstructural features in the solution of the structural problem.

SYSTEM AVAILABILITY

386 and 486 based with Interactive UNIX operating system PC's, Sun 4/SPARC, HP workstation, DEC workstation, IBM mainframe, CDC Cyber, CRAY

ATTRIBUTES

The system handles several types of analysis, including static response to concentrated and distributed loads, thermal expansion and enforced deformations, dynamic response to transient and steady-state sinusoidal loads, and random excitation. The system determines real and complex eigenvalues for use in analyzing vibration and dynamic and elastic stability. NASTRAN has limited capability for solving nonlinear problems, including piecewise linear analysis of nonlinear static response and transient analysis of nonlinear dynamic response.

ADDITIONAL REQUIREMENTS

SOURCE

The MacNeal-Schwendler Corporation
815 Colorado Boulevard
Los Angeles, CA 90041-1777
(213)258-9111, (800)336-4858

MATLAB

Matrix Computation

APPLICATION

MATLAB is a high performance interactive software program for scientific and engineering numeric computation. It combines numerical analysis, matrix computation, signal processing, and graphics with a user interface in which problems and solutions are expressed in standard math notation.

SYSTEM AVAILABILITY

386 and 486 based MS-DOS PC's, Macintosh, Sun 4/SPARC, Apollo, VAX/VMS

ATTRIBUTES

MATLAB provides interactive access to state-of-the-art linear algebra and matrix algorithms from LINPACK and EISPACK as well as other numeric techniques. MATLAB functions include: differential equation solution, polynomial operations, matrix computation, and complex arithmetic as well as powerful signal processing tools, such as 1-D and 2-D FFT's, spectral analysis, and digital filtering. In addition to its comprehensive set of scientific functions and matrix operations, MATLAB is fully extensible, allowing users to edit existing functions and to create new ones. To view data graphically, MATLAB provides 2-D linear, log, semi-log, and polar plots, and 3-D mesh and contour graphs.

ADDITIONAL REQUIREMENTS

SOURCE

MathWorks, Inc.
Cochituate Place, 24 Prime Park Way
Natick, MA 01760
(508)653-1415

MATLAB - CONTROL SYSTEM TOOLBOX

Matrix Computation

APPLICATION

MATLAB Control System Toolbox works with MATLAB to provide comprehensive functionality for control system design and analysis. It includes "classical" transfer function and "modern" state space control techniques, plus time domain and frequency domain responses, feedback gain selection, and model properties calculation.

SYSTEM AVAILABILITY

386 and 486 based MS-DOS personal computers, Macintosh, Sun 4/SPARC, Apollo, VAX/VMS

ATTRIBUTES

The toolboxes are delivered as MATLAB M-files, so the user can see the algorithms and implementations, as well as make changes or create new functions to address a particular application.

ADDITIONAL REQUIREMENTS

MATLAB

SOURCE

MathWorks, Inc.
Cochituate Place, 24 Prime Park Way
Natick, MA 01760
(508)653-1415

MATLAB - OPTIMIZATION TOOLBOX

Matrix Computation

APPLICATION

The MATLAB Optimization Toolbox contains a set of functions that implement the most widely used methods for performing minimization or maximization on general linear and nonlinear functions. For nonlinear minimization, this includes functions for unconstrained and constrained minimization, minimax, nonlinear least squares, and multi-objective and semi-infinite minimization. Functions for linear programming, quadratic programming, non-negative least squares, and solving nonlinear equations are included.

SYSTEM AVAILABILITY

386 and 486 based MS-DOS PC's, Macintosh, Sun 4/SPARC, Apollo, VAX/VMS

ATTRIBUTES

The Optimization Toolbox is implemented with MATLAB numeric computation software, which assures accurate results, fast performance, and portability. Most of the toolbox functions are delivered as MATLAB M-files, allowing the user to view the algorithms and implementations, as well as to make changes or create new functions to address a particular application.

ADDITIONAL REQUIREMENTS

MATLAB

SOURCE

MathWorks, Inc.
Cochituate Place, 24 Prime Park Way
Natick, MA 01760
(508)653-1415

MATLAB - SIGNAL PROCESSING TOOLBOX

Matrix Computation

APPLICATION

The MATLAB Signal Processing Toolbox works with MATLAB numeric computation software for 1-D and 2-D digital signal processing and time series analysis. The toolbox includes 1-D and 2-D FFT's and inverses, FIR and IIR filter design, filter response and simulation, and power spectrum estimation.

SYSTEM AVAILABILITY

386 and 486 based MS-DOS PC's, Macintosh, Sun 4/SPARC, Apollo, VAX/VMS

ATTRIBUTES

The Signal Processing Toolbox is delivered as MATLAB M-files, allowing the user to view the algorithms and implementations, as well as to make changes or create new functions to address a particular application.

ADDITIONAL REQUIREMENTS

MATLAB

SOURCE

MathWorks, Inc.
Cochituate Place, 24 Prime Park Way
Natick, MA 01760
(508)653-1415

MATLAB - SIMULINK

Matrix Computation

APPLICATION

SIMULINK is a powerful, interactive package for modeling, analyzing, and simulating dynamic nonlinear systems. SIMULINK employs a graphical, mouse driven interface, based on the X Window System.

SYSTEM AVAILABILITY

386 and 486 based MS-DOS PC's, Macintosh, Sun 4/SPARC, Apollo, VAX/VMS

ATTRIBUTES

SIMULINK supports linear, nonlinear, continuous time, discrete time, multivariable, multirate, and hybrid systems; models can be defined either as block diagram structures or by sets of differential equations. Fully integrated with the MATLAB numeric computation system, SIMULINK is suited for a broad range of system simulation problems.

ADDITIONAL REQUIREMENTS

MATLAB

SOURCE

MathWorks, Inc.
Cochituate Place, 24 Prime Park Way
Natick, MA 01760
(508)653-1415

MATLAB - SPLINE TOOLBOX

Matrix Computation

APPLICATION

The MATLAB Spline Toolkit contains a set of functions for the construction and use of piecewise polynomial functions.

SYSTEM AVAILABILITY

386 and 486 based MS-DOS PC's, Macintosh, Sun 4/SPARC, Apollo, VAX/VMS

ATTRIBUTES

The Spline Toolbox is implemented with MATLAB numeric computation software, which assures accurate results, fast performance, and portability. Most of the toolbox functions are delivered as MATLAB M-files, allowing the user to view the algorithms and implementations, as well as to make changes or create new functions to address a particular application.

ADDITIONAL REQUIREMENTS

MATLAB

SOURCE

MathWorks, Inc.
Cochituate Place, 24 Prime Park Way
Natick, MA 01760
(508)653-1415

MATLAB - SYSTEM IDENTIFICATION TOOLBOX

Matrix Computation

APPLICATION

The MATLAB System Identification Toolbox works with MATLAB numeric computation software package to build mathematical models of dynamic systems, based on observed I/O (input/output) data. Central features include parametric and non-parametric techniques for all phases of the system identification process: parametric estimation, spectral analysis, simulation, and presentation.

SYSTEM AVAILABILITY

386 and 486 based MS-DOS PC's, Macintosh, Sun 4/SPARC, Apollo, VAX/VMS

ATTRIBUTES

The System Identification Toolbox is delivered as MATLAB M-files, allowing the user to view the algorithms and implementations, as well as to make changes or create new functions to address a particular application.

ADDITIONAL REQUIREMENTS

MATLAB

SOURCE

MathWorks, Inc.
Cochituate Place, 24 Prime Park Way
Natick, MA 01760
(508)653-1415

MATRIXx

Matrix Computation

APPLICATION

MATRIXx is a comprehensive mathematical analysis tool for engineers and scientists. It is an interactive matrix manipulation environment that combines the powerful numerical tools of LINPACK and EISPACK with an easy to use interface, comprehensive graphics facility, and an expandable function library.

SYSTEM AVAILABILITY

386 and 486 based MS-DOS PC's, Sun 4/SPARC, IBM 739, IBM 930, HP UNIX workstations, VAX/VMS

ATTRIBUTES

MATRIXx is the entry-level tool for the ISI product family, which includes comprehensive systems analysis and control design, as well as nonlinear simulation, block diagram system modeling, and automatic real time code generation and implementation. MATRIXx features include:

- * Fast matrix calculator.
- * Comprehensive math programming environment.
- * Fast computations.
- * Extensive 2-D and 3-D graphics with Postscript output.
- * Extensive and extensible mathematical function library.
- * Intuitive, user friendly interface.

ADDITIONAL REQUIREMENTS

FORTRAN compiler

SOURCE

Integrated Systems, Inc.
3260 Jay Street
Santa Clara, CA 95054-3309
(408)980-1500, (800)675-MATH

MATRIXx - CONTROL DESIGN MODULE

Matrix Computation

APPLICATION

The Control Design Module, used with MATRIXx, performs sophisticated classical and modern control design and analysis including SI/SO (single input/single output), MI/MO (multiple input/multiple output), and multivariable applications.

SYSTEM AVAILABILITY

386 and 486 based MS-DOS PC's, Sun 4/SPARC, IBM 739, IBM 930, HP UNIX workstations, VAX/VMS

ATTRIBUTES

The Control Design Module contains a comprehensive set of functions for controls and systems engineers, including frequency and time response calculations, model reduction, root locus plots, and Kalman Filter design. The Control Design Module has the following features:

- * Classical tools
- * Modern tools
- * System representation
- * Conversions
- * System construction
- * Time responses
- * Steady state analysis

ADDITIONAL REQUIREMENTS

FORTRAN compiler, MATRIXx

SOURCE

Integrated Systems, Inc.
3260 Jay Street
Santa Clara, CA 95054-3309
(408)980-1500, (800)675-MATH

MACSYMA

Symbolic Manipulation

APPLICATION

MACSYMA is an interactive expert system and programming environment designed to assist in solving a wide spectrum of mathematical problems. MACSYMA offers symbolic and numeric manipulation and solution capabilities in algebra, calculus and numerical analysis, 2-D and 3-D report quality graphics, interfaces with mathematical text processors, and a user programming environment.

SYSTEM AVAILABILITY

386 and 486 based MS-DOS PC's, Sun 4/SPARC, IBM, HP UNIX workstations, Silicon Graphics, Symbolics

ATTRIBUTES

MACSYMA combines symbolic, numerical and graphical mathematics in one software package, with over 1,500 documented commands, and 600 executable demonstrations. MACSYMA's features include: Algebra - arithmetic, basic algebra, trigonometry, matrix algebra, solving equations (exact, approximate, numerical), sums and products, special functions. Calculus - differentiation and limits, Taylor series methods, indefinite integration, integral transforms, first and second order O.D.E.'s, systems of linear O.D.E.'s, perturbation methods, and numerical solutions. Vector and Tensor Analysis - vector calculus (dot and cross products, grad, div, curl, Laplacian operators, and many simplification options. Graphics - 2-D and

3-D plots, and other plot utilities. Utilities - pattern matching, properties data base, foreign language interface (FORTRAN and C code manufacturing), TeX output generator, and can also generate complete programs from symbolic specs.

ADDITIONAL REQUIREMENTS

SOURCE

MACSYMA Inc. (formerly SYMBOLICS Inc.)
20 Academy Street
Arlington, MA 02174
(617)646-4550

MAPLE

Symbolic Manipulation

APPLICATION

MAPLE is a powerful interactive system for algebraic manipulation or symbolic computations. MAPLE's facilities include arithmetic with integers, fractions, unknown variables, polynomials and general expressions, solving equations, factoring, taking derivatives and series expansions of functions, indefinite and definite integration, solving differential equations, matrix operations, plotting, and more.

SYSTEM AVAILABILITY

386 and 486 based MS-DOS PC's, Amiga DOS, Macintosh,
Sun 4/SPARC, IBM VM/CMS

ATTRIBUTES

MAPLE has an extensive library of approximately 2,000 procedures to provide access to the mathematical operations commonly used in science and engineering. Specific applications include VLSI design, relativistic physics, satellite guidance systems and electrical engineering. Some of the packages currently implemented in the MAPLE libraries include linear algebra, number theory, statistics, group theory, linear optimization, differential forms, and student calculus. An important property of MAPLE

is that most of the algebraic facilities in the system are implemented using the high-level user language. The basic system, or kernel, is sufficiently compact and efficient to be practical for use in a shared environment or on personal computers with as little as 2 megabytes of main memory. The MAPLE kernel can produce input for C, FORTRAN, TeX, and a number of other standard systems.

ADDITIONAL REQUIREMENTS

SOURCE

Waterloo Maple Software
160 Columbia Street W.
Waterloo, ON N2L 3L3 Canada
(519)747-2373

MATHEMATICA

Symbolic Manipulation

APPLICATION

MATHEMATICA, a general system for doing mathematics by computer, is used as an interactive calculation tool and as a programming language. MATHEMATICA does numerical, graphical, and symbolic calculations. Capabilities include arbitrary precision arithmetic, special function evaluation, matrix manipulation, symbolic computation, and formulas manipulation directly in algebraic form. MATHEMATICA contains a core of mathematical knowledge, which can be extended by creating programs in the MATHEMATICA language. The language incorporates several hundred programs for numerical, symbolic, and graphical programming, and has extensive graphic capabilities.

SYSTEM AVAILABILITY

386 and 486 based MS-DOS PC's, Macintosh, Sun 4/SPARC, IBM RISC/6000, CONVEX C, SGI, and others

ATTRIBUTES

MATHEMATICA has over 600 built-in functions to support numerical and symbolic computation, as well as 2-D and 3-D graphics. The system permits

users to create their own libraries for specialized computing environments. MATHEMATICA can evaluate a range of mathematical functions, including calculations using exact integers, rationals, complex numbers, and all standard special functions of mathematical physics. Symbolic computational abilities include polynomial operations, rational functions operations, calculus, equation solving, symbolic matrix operation, list operations, and tensor operations. The kernel works the same on all computers, and can produce input for C, FORTRAN, TeX, and other standard systems.

ADDITIONAL REQUIREMENTS

SOURCE

Wolfram Research Inc.
P.O. Box 6059
Champaign, IL 61826
(217)398-0700, (800)441-MATH

LOGICAL DECISION

Systems Engineering

APPLICATION

LOGICAL DECISION performs quantitative decision analysis. Based on a set of alternatives and a set of quantitatively measured characteristics to evaluate the alternatives, LOGICAL DECISION systematically formulates the preferences about the characteristics and then combines the information to provide a quantitative ranking of the selected alternatives. LOGICAL DECISION is capable of handling complex preferences, and alternatives with uncertainties, defined and described the way that makes the best sense to the user. Powerful methods from the field of decision analysis are used to quantify the preferences. Interactive features of the software permit evaluation of the alternatives instantly once alternatives and user preferences have been quantified.

SYSTEM AVAILABILITY

IBM PC/XT/AT or 100 percent compatible

ATTRIBUTES

LOGICAL DECISION provides the following features:

*Provides freedom in defining evaluation measures. Scales can be discrete or continuous, increasing or decreasing, with no restrictions on the range or number of scale points allowed.

- * Handles up to 500 alternatives and 100 evaluation measures.
- * Allows the description of alternatives using probabilities.
- * Uses graphical assessment of preferences concerning single and multiple measures.
- * Allows consistency checking and of preferences.

ADDITIONAL REQUIREMENTS

SOURCE

Logical Decisions
164 E. Scenic Avenue
Point Richmond, CA 94801
(415)233-8920

MICROSOFT PROJECT

Systems Engineering

APPLICATION

MICROSOFT PROJECT assists in project organization and management, combining the power of CPM (Critical Path Method) scheduling with a direct access to graphical environment. Direct Graphics allows flexibility and control needed to create and organize a project. With the reporting capabilities of MICROSOFT PROJECT, one can create, modify, and print quality reports. MICROSOFT PROJECT supports the transfer of information to other applications.

SYSTEM AVAILABILITY

286 (or higher) based MS-DOS PC's, Macintosh

ATTRIBUTES

The three main features used in MICROSOFT PROJECT to create, manage, and report a project are: Views, Tables, and Filters. Views is used to enter, organize, and examine tasks or resources. Using the Views menu, one can switch to the view that is best for the application. The Views menu consists of "traditional" project management charting tools: Gantt Chart, PERT Chart, Resource Form, Resource Graph, Resource Sheet, Resource Usage View, Task Entry View, Task Form, Task PERT Chart, and Task Sheet. By choosing different views from the Views menu, one may determine the desirable display of the project information. By applying Table or Filter to a view, the exact appearance of the information may be determined. By applying different tables, one can change the columns of information that appear in the views, while using a filter one can either display or highlight only the tasks or resources of interest.

ADDITIONAL REQUIREMENTS

SOURCE

Microsoft Corporation
One Microsoft Way
Redmond, WA 98052
(800)426-9400

RDD-100 SYSTEM DESIGNER

Systems Engineering

APPLICATION

Requirements Driven Development (RDD) is a software tool suite which encompasses all aspects of system design. In RDD, system behavior can be observed at all stages of the design process. RDD supports requirements analysis, functional design and specifications, allocation to subsystems and computers, and design of interfaces. RDD's graphic language describes real, dynamic system behavior, and includes constructs for integrated description of functions, conditions, interfaces, and flow of data or materials with control. RDD has a simulator which directly executes the design objects.

SYSTEM AVAILABILITY

386 and 486 based MS-DOS PC's, Macintosh, Sun 4/SPARC, HP-UX807, DEC workstation

ATTRIBUTES

RDD-100 System Designer facilitates the construction, maintenance, display, and documentation of design objects that specify behavior. Objects include requirements, functions, components, and the sources and decisions that lead to the system architecture. Objects are created and edited by graphics or text, with multiple generated views available to gain different perspectives. At the core of RDD is an extensible object base of data for system description, archiving and management, which follows the element-relationship attribute schema. Templates and consistency checks verify system design sufficiency.

ADDITIONAL REQUIREMENTS

SOURCE

Ascent Logic Corporation
180 Rose Orchard Way, Suite 200
San Jose, CA 95134
(408)943-0630

TEAMWORK

Systems Engineering

APPLICATION

TEAMWORK provides an integrated Computer-Aided Software Engineering (CASE) environment for system and software automated development. TEAMWORK provides a multi-user development system that takes advantage of advanced engineering workstation technologies such as interactive computer graphics, high performance servers, and industry standard, heterogeneous networks. The TEAMWORK environment provides the foundation for complete, concept to code CASE solution based on the unified CASE strategy. The TEAMWORK project database provides the foundation for every development project, particularly for project teams that use network workstations. Project information is stored in a central project database. The project data

base contains the specifications and design models, the project data dictionary, project management data, project notes (both textural and graphic), documentation, and version and configuration details.

SYSTEM AVAILABILITY

IBM/OS-2, Sun 4/SPARC, HP300, HP400, HP700, VAX/VMS, Silicon Graphics, and others

ATTRIBUTES

The entire TEAMWORK product family shares an extensible, open architecture for seamless integration with other CASE tools, and is identical on all hardware platforms. Some of these toolkits are: IM (information modeling) for the analysis phase; SA (structured analysis); RT (real time) to enable analysts and designers to create, store, review, and maintain structured system specification; SIM (simulation and modeling); and others.

ADDITIONAL REQUIREMENTS

SOURCE

CADRE Technologies Inc.
222 Richmond Street
Providence, RI 02903
(401)351-CASE, (800)743-2273

TIMELINE 4.0

Systems Engineering

APPLICATION

TIMELINE is a PC class program/project management software that supports PERT, resource leveling, and detailed scheduling.

SYSTEM AVAILABILITY

IBM XT/AT or 100 percent compatible

ATTRIBUTES

TIMELINE performs WBS/OBS, link schedules, critical path, block time, lag time, dependencies, and resource leveling As Soon As Possible & As Late As Possible tasks. The software can handle 1,000 tasks per schedule, with task determined over minutes, hours, or days. TIMELINE can also support lead/lag dependencies, partial resource allocations, and sub-schedule roll ups.

ADDITIONAL REQUIREMENTS

SOURCE

Symantec Corporation
10201 Torre Avenue
Cupertino, CA 95014
(408)253-9600

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